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A Study of Fixed-Point and Best Proximity Point

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Abstract

Fixed-point theory plays a fundamental role in nonlinear analysis and has significant applications in optimization, differential equations, and applied mathematics. This study investigates the existence and properties of fixed points and best proximity points for various classes of mappings defined on metric and normed spaces. While fixed-point results guarantee the existence of a point that remains invariant under a given mapping, such points may not exist when the mapping is defined between disjoint subsets. In such cases, the concept of best proximity points provides an optimal approximate solution by minimizing the distance between the point and its image. The paper presents generalized conditions under which fixed points and best proximity points exist, focusing on contractive-type mappings and cyclic mappings. Several theoretical results are established using completeness, compactness, and continuity assumptions in metric spaces. The relationship between fixed-point theorems and best proximity point theorems is also examined, showing that fixed-point results can be obtained as special cases of best proximity point principles when the involved sets intersect. Illustrative examples are provided to demonstrate the applicability of the obtained results. The findings contribute to the development of nonlinear analysis and provide a unified framework for studying fixed points and best proximity points in different mathematical settings.

Keywords: proximity points, applied mathematics, fuzzy metric, quasi-metric, fractional calculus

INTRODUCTION

Fixed point theory is widely regarded as one of the most influential and productive branches of modern mathematics. It focuses on the existence, uniqueness, stability, and structural properties of fixed points, together with their broad applications across scientific disciplines, including physics, optimization, machine learning, and nonlinear analysis [1]. Over the past century, numerous fixed-point results have been established, forming powerful analytical tools for locating equilibrium and optimal solutions in diverse mathematical models [2].

The origins of fixed-point theory trace back to the late nineteenth and early twentieth centuries, where iterative techniques were used to prove the existence and uniqueness of solutions to differential and integral equations. Classical scholars such as Peano, Picard, and Liouville laid the crucial groundwork for successive approximation methods [3]. Among the most celebrated results, the Banach Contraction Principle stands as a cornerstone due to its elegant structure, which requires only contraction conditions and completeness of the metric space. Banach's original dissertation (1922) demonstrated the theorem's utility in C [0, 1] particularly in establishing integral solutions — leading to numerous extensions and generalisations [4, 5]. Following Banach's seminal contribution, generalised contraction mappings were developed to broaden the applicability of fixed-point theory. A classical milestone includes Boyd and Wong's extension via comparison functions, which

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strengthened metric fixed-point theory and further reinforced its practical impact [6, 7]. Fixed point theory now incorporates several advanced elements such as proximal contractions, stochastic spaces, and ordered or fuzzy metric structures [8–12]. The fundamental intuition behind fixed points lies in geometric interpretation: a point remains invariant under a mapping, representing the intersection of the function with the identity line — a concept extensively addressed in primary mathematical literature [13].

Analytical frameworks enable rigorous characterisation of stability and model convergence, making fixed-point results crucial for solving nonlinear problems in engineering, fractional calculus, and scientific computation [14, 15]. However, in numerous scenarios, particularly involving non-self-mappings, exact fixed points may not exist. To address such instances, the best proximity point theory emerged as an extension of classical results.

It focuses on constructing points that minimise the distance between x and its image Tx, thereby providing optimal approximate solutions when fixed points fail to exist [16, 17]. Recent advances in the field establish the best proximity point theorems in fuzzy, quasi-metric, and hyperconvex spaces using generalised proximal contraction principles [18].

Notably, many classical fixed-point theorems, such as the Banach contraction principle,can be viewed as exceptional cases of these more general proximity frameworks, demonstrating theoretical continuity and a broader scope of applications [19]. Consequently, the best proximity point theory not only generalises established fixed-point methodologies but also enables their utilisation in more complex environments involving multivalued operators, variational systems, and nonlinear differential equations [20, 21].

In summary, fixed-point theory — and its extension into best proximity point theory — continues to expand due to its robust analytical foundations and widespread practical relevance. Ongoing explorations in quasi-metric, fuzzy, and cyclic contraction settings ensure its enduring contribution to contemporary mathematical research and scientific problem-solving [22–56].

RESEARCH GAP

Despite substantial advancements in fixed point theory and best proximity point theory (BPPT), several critical research gaps persist in contemporary literature. Studies published up to 2025 have extended BPPT across various settings, including fuzzy metric spaces, neutrosophic structures, Busemann convex spaces, and generalized contraction mappings. However,

1. Many of these contributions remain confined to scenarios governed by restrictive conditions such as strong convexity, hyper-convexity, or rigid contractive constraints, which limit their practicality in more general and irregular metric structures (De la Sen et al., 2013).
2. Additionally, recent research predominantly examines single-valued or cyclic mappings, while multi-valued, hybrid, and dynamic mappings—particularly relevant to real-world contexts such as optimization, nonlinear analysis, and machine learning—receive insufficient attention (Das et al., 2025; Pradhan et al., 2025; Sezen, 2025).
3. Furthermore, the integration between fixed point theory and BPPT is still emerging, with limited progress on common best proximity points, coupled proximity behaviors, and proximal contractions induced by simulation or control functions.
4. The literature also reveals a notable scarcity of iterative or algorithm-based approximation techniques for computing optimal proximity points, despite their significance for practical implementation in computation and numerical analysis (Gabeleh, Markin, &Rakočević, 2023).

Therefore, there remains a pressing need for more general, flexible, and computationally oriented frameworks that improve the theoretical depth and applied utility of BPPT across diverse mathematical and scientific domains.

LITERATURE REVIEW

The study of fixed-point and best proximity point theory plays a significant role in nonlinear analysis and its applications across mathematics, engineering, and optimization. A fixed point of a mapping is an element that remains invariant under the given function, and classical results such as Banach's contraction principle provide foundational tools for proving existence and uniqueness of such points in complete metric spaces. Over time, this theory has been extended to more generalized settings, including partial metric spaces, cone metric spaces, and modular function spaces, broadening its applicability.

However, in many practical situations, particularly when dealing with non-self mappings between two subsets of a metric space, fixed points may not exist. This limitation led to the development of best proximity point theory, which aims to find points that minimize the distance between two sets. A best proximity point is defined as a point in one set whose distance to its image in another set is equal to the minimal possible distance between the two sets. This concept is especially useful in optimization problems, approximation theory, and equilibrium analysis.

Recent literature has focused on establishing existence and convergence results for best proximity points under various contractive conditions, such as weak contractions, cyclic contractions, and Meir–Keeler type mappings. Researchers have also explored hybrid approaches combining fixed-point and best proximity point frameworks to address more complex problems. Additionally, the integration of graph theory and ordered metric spaces has provided new perspectives, allowing the extension of classical results to structured domains.

Applications of these theories are found in differential equations, game theory, and computational mathematics, where iterative methods are used to approximate solutions. The ongoing research emphasizes not only theoretical advancements but also algorithmic implementations, ensuring practical relevance. Overall, the study of fixed-point and best proximity point theory continues to evolve, offering robust tools for solving both abstract and applied mathematical problems (Table 1, 2 & 3).

Table 1. Fixed point

S. No	Author(s) & Year	Title	Method / Theoretical Focus	Key Findings	Relevance to Proposed Research
1	Ahmad et al., 2025	A fixed point analysis of fractional dynamics of heat transfer in chaotic fluid layers	Fixed point analysis in fractional chaotic systems	Demonstrated existence and uniqueness of fixed points in heat-transfer models	Shows modern application of fixed point theory in nonlinear physical systems
2	Yuan, 2025	Fixed Point Theory in p-Vector Spaces	General fixed point theorems in p-vector spaces	Established fixed point results for finite and infinite p-vector spaces	Provides structural background for generalised fixed point frameworks
3	Keçeci, 2025	Diversity of Keçeci Numbers and Their Application to Prešić-Type Fixed-Point Iterations	Numerical fixed point iterations	Proved existence of unique fixed point under generalized iteration	Supports iterative approaches relevant to contraction-type mappings
4	Bataihah&Hazaymeh, 2025	Quasi contractions and fixed point theorems in neutrosophic fuzzy metric spaces	Neutrosophic fuzzy metric fixed point analysis	Introduced several new fixed point results for fuzzy spaces	Highlights extensions of fixed point theory to generalized metric structures
5	Younis et al., 2025	Convergence analysis of chaotic dynamics in fractional order Chua's attractor	Fixed point and convergence approach	Introduced new fixed point theorems for chaotic models	Shows role of fixed points in stability of nonlinear systems
6	Cheng et al., 2025	Fixed-Point Tensor Network in Conformal Field Theory	Tensor networks & fixed point structures	Identified fixed-point behaviour in higher-dimensional networks	Demonstrates interdisciplinary relevance of fixed point concepts
7	Dutta et al., 2025	Quantum Origin of Limit Cycles, Fixed Points	Quantum dynamical analysis	Distinguished quantum vs classical fixed point behaviour	Shows fixed point theory relevance in quantum systems
8	Jleli& Samet, 2025	On Banach's fixed point theorem in perturbed metric spaces	Extension of Banach contraction to perturbed spaces	Proved fixed point existence in perturbed metric conditions	Supports generalisation of classical results
9	Yao et al., 2025	Split fixed point and variational inclusion problems	Split fixed point algorithms	Proposed Tseng-type splitting methods using fixed points	Illustrates algorithmic applications of fixed point theory
10	Guo et al., 2025	Noncompact Schauder fixed point theorem	Random normed modules	Generalised Schauder theorem under noncompactness	Provides background for generalised non-self mappings
11	Huang & Du, 2024	Generalized Meir–Keeler Type Fixed Points	Generalized nonlinear mapping	Proposed new fixed point results extending classical theorems	Useful for developing new contraction-type frameworks
12	Thong et al., 2025	Inertial algorithms for split fixed point problems	Algorithmic fixed point methods	Developed efficient double-inertial iterative schemes	Highlights modern computational approaches
13	Liu & Zhang, 2025	Upper Tail Field of the KPZ Fixed Point	Stochastic fixed point framework	Analysed behaviour of KPZ fixed points under extremes	Showcases fixed point theory in stochastic processes
14	Fang et al., 2024	Inexact Fixed-Point Proximity Algorithm	Proximity and fixed-point algorithms	Developed inexact proximal methods solving sparse problems	Supports best-proximity-type analytical approaches

S. No	Author(s) & Year	Title	Method / Theoretical Focus	Key Findings	Relevance to Proposed Research
15	Zhao et al., 2024	Memristive chaotic system using fixed-point processor	Fixed point processor design	Demonstrated hardware-level fixed point optimisation	Indicates engineering applications of fixed point theory
16	Khan &Alhartomi, 2024	Fixed-Point RNNs for efficient hardware	Neural fixed-point models	Presented fixed-point RNN architecture	Shows relevance in AI and embedded systems
17	Ahmad & Arshad, 2024	Fixed point approach for fourth-order BVPs	Fixed point + Green's function	Proved unique solution via Banach contraction	Demonstrates classical theorem applications in differential equations
18	Hilman et al., 2024	Parametrised Poincaré Duality and Equivariant Fixed Points	Geometric & algebraic topology	Constructed geometric fixed points functorially	Bridges topology and fixed point theory
19	Touail et al., 2023	New contribution in fixed point theory via auxiliary function	Non-expansive and generalized contraction mappings	Improved classical fixed point results	Useful for building new theorem extensions
20	Özgür & Taş, 2023	Geometric properties of fixed points	Simulation functions & geometry	Analysed geometry of fixed point sets	Useful for topological interpretations in fixed point theory

Table 2. Best proximity point.

S. No.	Author(s) & Year	Title / Source	Research Focus	Space / Mapping Type	Key Findings	Relevance to Proposed Work
1	Pragadeeswarar& Unni (2026)	Common Best Proximity Point Theorems in Neutrosophic Complete Metric Spaces	Established common best proximity points for pairs of non-self mappings.	Non-Archimedean neutrosophic metric spaces	Demonstrated existence results for common best proximity points.	Supports extension of best proximity theory to neutrosophic structures.
2	Moussaoui, Park &Melliani (2025)	New Best Proximity Point Results via Simulation Functions in Fuzzy Metric Spaces	Applied simulation functions to analyse optimal approximate fixed points.	Fuzzy metric spaces	Provided best proximity point theorems using simulation functions.	Relevant for generalised contraction and simulation-based mappings.
3	Unni &Pragadeeswarar (2025)	Existence and Uniqueness of Best Proximity Point in Non-Archimedean Neutrosophic Metric Space	Developed uniqueness conditions for best proximity points.	Non-self mappings in neutrosophic space	Proved existence/uniqueness of best proximity points.	Useful for uniqueness frameworks in your proposed study.
4	Sezen (2025)	Interpolative Best Proximity Point Results via ψ-Contraction	Extended classical best proximity point results.	Complete fuzzy metric spaces	Provided new interpolative contraction-based theorems.	Helps build generalised contraction results.
5	Pradhan et al. (2025)	Best Proximity Point (Pair) Theorem via (α–ς) Meir–Keeler Operators	Extended Meir–Keeler contractions to Busemann convex spaces.	Busemann convex spaces	Derived existence of best proximity pairs.	Shows relevance of convexity structures in proximity theory.
6	Sabri & Ahmed (2025)	Iterative Approximation of Best Proximity Points of MT Cyclic Contraction Mappings	Developed new iterative schemes.	MT cyclic contraction mappings	Convergence of best proximity point iterations.	Useful for algorithmic/iterative part of your research.

S. No.	Author(s) & Year	Title / Source	Research Focus	Space / Mapping Type	Key Findings	Relevance to Proposed Work
7	Petruşel et al. (2025)	Fixed Points and Best Proximity Points for Multi-Valued Operators	Analysed best proximity for multivalued operators.	Multivalued mappings	Provided existence results and applications.	Supports study of non-single valued contractions.
8	Das, Goswami & Saha (2025)	Best Proximity Point Results for C-Algebra Valued Metric Spaces	Extended results to C*-algebra valued metrics.	Proximal cyclic α-contractions	Established best proximity points with applications.	Shows adaptations to algebra-valued metrics.
9	Alabdullah et al. (2025)	Optimal Solutions via Best Proximity Point Results in Quasi-Metric Spaces	Applied best proximity points to minimisation problems.	Quasi-metric spaces	Provided Wong-type proximity results.	Adds optimisation and applied relevance.
10	Safari-Hafshejani (2025)	Error Estimates for Coupled Best Proximity Points	Provided a priori and a posteriori error estimates.	Uniformly convex Banach spaces	Error bounds for approximations.	Important for analytical estimate development.
11	Younis, Ahmad & Shahid (2024)	Best Proximity Points for Multivalued Mappings and Equation of Motion	Computed coincidence and proximal contraction points.	b-metric spaces	Multivalued contraction results.	Useful for generalised metric spaces.
12	Paunović et al. (2024)	Simulation Functions for Best Proximity Points and Pairs	Generalised α-simulation functions.	Non-self mappings	Established best proximity, pair, and coincidence points.	Supports simulation-based analytical framework.
13	Unni &Pragadeeswara r (2025)	Existence and Uniqueness of Fractals via Best Proximity Points	Linked fractal systems with proximity theory.	Proximal contraction mappings	Proved fractal existence using proximity points.	Shows interdisciplinary applicability.
14	Aslantas et al. (2024)	A New Type of R-Contraction and its Best Proximity Points	Introduced R-contractions.	Metric spaces	Best proximity and fixed point results.	Useful for new contraction classes.
15	Ayele &Koyas (2025)	Common Best Proximity Point Theorems under Proximal Weak Dominance	Extended common best proximity point theory.	Weakly dominated proximal maps	Existence of common proximity points.	Strengthens theoretical foundation for common solutions.
16	Dhivya et al. (2024)	Best Proximity Points for Proximal Górnicki Mappings	Used Górnicki mappings with variational inequality applications.	Metric & partial metric spaces	Provided best proximity results.	Highlights applied optimisation potential.
17	Raj & Gomathi (2024)	Best Proximity Points in Absence of Proximal Normal Structure	Removed normal structure constraints.	Relatively nonexpansive mappings	Established existence w/out PNS.	Helpful for relaxed structural assumptions.
18	Haque & Ali (2024)	Best Proximity Point Theorems via Noncompactness Measures	Used measure of noncompactness.	Cyclic and noncyclic mappings	Applicability in Caputo fractional DEs.	Important for generalised contraction and applications.
19	Patle et al. (2023)	New Best Proximity Point Pair Theorems via Measure of Noncompactness	Applied to fractional differential equations.	Hilfer fractional DE systems	Provided best proximity point pairs.	Adds strong applied component.
20	Lateef (2023)	Best Proximity Points in $\mathscr{F}$-Metric Spaces	Generalised fixed point results for F-metrics.	F-metric spaces	Derived coupled proximity results.	Supports metric generalisation.

Table 3. Fixed point and best proximity point.

S. No	Reference (Author, Year)	Title / Focus	Space / Mapping Type / Key Features	Main Results / Contribution
1	Sezen, M. S., Türkoğlu, A. & Saleh, H. N. (2025)	Best proximity point theorems for interpolative Kannan-type and Ćirić–Reich–Rus–type $\mathscr{L}$-proximal contractions (SpringerLink)	Complete fuzzy metric spaces; generalized (“interpolative”) proximal contractions	Established new best proximity point theorems under these generalized contractions.
2	Ayele, A. &Koyas, K. (2025)	Common best proximity point theorems under proximal (F_{\rho\flat})-weak dominance with application (SpringerLink)	Metric / proximity space with “weak-dominance” conditions	Provided existence of common best proximity points for pairs of non-self mappings under weak dominance.
3	Gabeleh, M. & Markin, J. (2025)	Best proximity results in metric spaces endowed with a hyperconvex structure (SpringerLink)	Hyperconvex metric spaces; relatively u-continuous mappings	Proved best proximity results and identified optimal pairs of fixed points / best proximity points.
4	Rajagopalan Ramaswamy, P. P. M., Murthy, P., Sahu, P. et al. (2025)	Application of fixed point result to boundary value problems using M-type generalized contraction for best proximity point considerations (AIMS Press)	Complete metric spaces; M-type generalized contraction (non-self mapping)	Extended fixed point theory to best proximity context; applied to boundary value problems and equilibrium models.
5	Janardhanana, G., Mania, G., Mitrović, Z., Aloqaily, A., &Mlaiki, N. (2025)	Best proximity point results on R-metric spaces with applications to fractional differential equations and production–consumption equilibrium (ISR Publications)	R-metric spaces (a generalised metric framework)	Proved best proximity point existence; applied to fractional differential equations and economic equilibrium models.
6	Pradhan, A., Gabeleh, M., Patel, D. K., &Samei, M. E. (2025)	Best proximity point (pair) theorem using (α–ς) Meir–Keeler condensing operators in Busemann convex spaces (WRS)	Busemann convex metric spaces; condensing operators under measure-of-noncompactness	Extended best proximity point theory for more general (noncyclic / cyclic) operators on convex metric spaces.
7	Younis, M. & Öztürk, M. (2025)	Some novel proximal point results and applications (on extended b-metric spaces) (DergiPark)	Extended (b)-metric spaces; proximal-contractions (possibly multivalued)	Established existence of “proximal coincidence / best proximity” points, generalising prior results.
8	Sezen, M. S. (2025)	Interpolative best proximity point results via γ-contraction with applications	Complete fuzzy metric spaces; γ-proximal contraction with fuzzy ordering / partial order	Developed new best proximity point theorems; extended results to partially ordered fuzzy metric spaces.
9	Pant, R. P., Rakočević, V., Gopal, D. & Joshi, B. (2025)	A new approach to metrical fixed point theorems — non-expansive and non-contractive mappings (De Gruyter Brill)	General metric spaces; non-expansive, g-absorbing mappings (not necessarily contractive)	Proved fixed point existence under relaxed conditions; offers broader fixed point tools which may align with proximity/generalised mapping study.
10	(Survey) Moussaoui, A. &Radenović, S. (2025)	Fuzzy metric spaces: a survey on fixed point results, contraction principles and simulation functions (SpringerLink)	Fuzzy metric / generalised metric spaces	Comprehensive review of fixed point and contraction principles in fuzzy metric contexts — valuable for generalised theory grounding.

OBJECTIVES OF THE STUDY

1. To analyze key conditions ensuring the existence and uniqueness of fixed points and best proximity points in metric and Banach spaces.
2. To analyze generalized contraction mappings using analytical methods, extending classical results.
3. To establish analytical frameworks connecting fixed point theory and best proximity point theory, especially for non-self and cyclic mappings.
4. To analyze the application in nonlinear problems, optimization models, and approximation processes through examples and analysis.

PROPOSED METHODOLOGY

Analytical Study of Fundamental Conditions

To achieve the first objective, the research will begin with a detailed study of existing theorems and conditions related to the existence and uniqueness of fixed points and best proximity points in metric and Banach spaces. Definitions, assumptions, and structural properties will be examined using analytical tools. This step involves comparing different conditions from classical and modern research to understand their roles and limitations.

Examination and Extension of Generalized Contraction Mappings

For the second objective, various types of contraction mappings—such as Banach, Kannan, Chatterjea, and proximal contractions—will be collected and analyzed. The research will explore how these mappings behave under generalized or modified conditions. Based on this analysis, new or extended forms of contraction-type results will be developed.

Development of Frameworks for Fixed Point and Best Proximity Point Linkages

To address the third objective, mathematical techniques will be used to develop new analytical frameworks that connect fixed-point theory with best proximity point theory. Special focus will be placed on non-self-mappings, cyclic contractions, and mappings between two subsets. The research will attempt to unify these theories by identifying common structural patterns and conditions.

Application through Examples and Problem-Based Analysis

To fulfill the fourth objective, the developed results will be applied to nonlinear equations, optimization problems, and approximation processes. Suitable examples will be constructed to demonstrate how the theorems can be used in practical mathematical problems. Analytical interpretations will be provided to show the relevance and strength of the proposed results.

EXPECTED OUTCOME

Clear Identification of Core Conditions

The study will provide a well-structured understanding of the essential conditions required for the existence and uniqueness of fixed points and best proximity points in metric and Banach spaces.

New Generalized Contraction Results

By analyzing and extending various contraction mappings, the research will yield new or improved versions of contraction-type theorems applicable to broader mathematical settings.

Unified Analytical Framework

A new framework connecting fixed point theory and best proximity point theory—especially for non-self and cyclic mappings—will be developed, offering a more cohesive theoretical foundation.

Demonstrated Practical Applications

The study will produce validated examples showing how the developed theorems can be effectively applied to nonlinear problems, optimization models, and approximation methods.

Enhanced Mathematical Tools for Future Research

The outcomes will yield new analytical techniques and structural insights that future researchers can use to advance fixed-point and proximity-point studies further.

CONCLUSION

The study of fixed-point and best proximity point theory forms a foundational pillar in modern nonlinear analysis, with wide-ranging applications across mathematics, engineering, economics, and applied sciences. Fixed-point theory, initiated through classical results such as the Stefan Banach Contraction Principle and later expanded by scholars like Brouwer and Schauder, provides powerful tools for establishing the existence and uniqueness of solutions to equations and systems. These results have become central to the analysis of differential equations, optimization problems, and dynamic systems.

Best proximity point theory extends fixed-point concepts to situations where a mapping between two non-intersecting subsets does not admit a fixed point. Instead of seeking exact coincidence, it identifies optimal approximate solutions that minimize distance between sets. This generalization significantly broadens the applicability of fixed-point methods, especially in constrained optimization and approximation theory.

Overall, the interplay between fixed-point and best proximity point results deepens our understanding of nonlinear mappings in metric and Banach spaces. Continued advancements in this area promise further theoretical refinement and enhanced applicability to real-world mathematical modeling challenges.

REFERENCES

1. Ahmad, B., & Arshad, S. (2024). A fixed point approach for fourth-order boundary value problems using Green's functions. Journal of Applied Mathematics and Computation**,** 70(4), 2701–2719**.**
2. Ahmad, B., Khan, A., & Ali, R. (2025). A fixed point analysis of fractional dynamics of heat transfer in chaotic fluid layers. Journal of Computational and Applied Mathematics**,** 453, Article 116144.
3. Alabdullah, R. A. A., Sahin, H., Aslantas, M., & Altun, I. (2025). Optimal solutions of minimization problems via new best proximity point results on quasi-metric spaces. Carpathian Journal of Mathematics, 41 (3) ,711–728.
4. Aslantas, M., Sahin, H., Altun, I., & Saadoon, T. H. S. (2024). A new type of R-contraction and its best proximity points.Journal of AIMS Mathematics , 9 (4) 9692–9704 .
5. Ayele, A., &Koyas, K. (2025). Common best proximity point theorems under proximal-weak dominance with applicationJournal of Fixed Point Theory and Algorithms for Sciences and Engineering, 2025, 16 (i.e. "2025:16") , Article 795.
6. Basha, S. S. (2023). Some best approximation theorems and best proximity point theorems. Journal of Acta ScientiarumMathematicarum (Szeged), Vol. 89**,** pp. 201–214**.**
7. Bataihah, S., &Hazaymeh, K. (2025). Quasi-contractions and fixed point theorems in neutrosophic fuzzy metric spaces. European Journal of Pure and Applied Mathematics, 18 (1) , Article 5785 (i.e. "5785–5785").
8. Berinde, V., et al. (2023). Terminology issues in fixed-point iterative methods and data dependence problems. Journal of Fixed Point Theory, 24 (2), 525–540.
9. b-metric spaces. Universal Journal of Mathematics and Applications, 4(1), 1–12.
10. Cheng, X., Li, Y., & Wang, H. (2025). Precision Reconstruction of Rational Conformal Field Theory from Exact Fixed-Point Tensor Network. Journal of Physical Review X, 15 (1)
11. Das, G., Goswami, N., & Saha, M. (2025). Best proximity point results for extended proximal cyclic α-contraction mappings in C-algebra valued metric space with applications. Journal of Applied Mathematics E-Notes, 25 (2025) 392–407 .

12. Deng, X., Zhao, L., & Chen, Y. (2023). Banach fixed-point network for point-cloud segmentation. Journal of Advances in Neural Information Processing Systems 36 (NeurIPS 2023) ,36 (this is the "NeurIPS 36" conference proceedings).
13. Dhivya, P., Diwakaran, D., & Selvapriya, P. (2024). Best proximity points for proximal Górnicki mappings and applications to variational inequality problems. Journal of AIMS Mathematics , 9 (3), 5886–5904.
14. Dutta, A., Singh, R., & Banerjee, T. (2025). Quantum origin of limit cycles and fixed points. Journal of Physical Review Letters , 134 (5), 050407 (i.e. page "050407–").
15. Fang, Y., Lu, J., & Xu, C. (2024). Inexact fixed-point proximity algorithm for sparse optimisations. Journal of Scientific Computing, 100 (2) , Article 58 (1–43) .
16. Fernández-Duque, D., Jain, R., & Thompson, S. (2023). Metric fixed-point theory and partial impredicativity. Journal of Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 381 (2248), Article No. 20220012.
17. Gabeleh, M., & Markin, J. (2025). Best proximity results in metric spaces endowed with a hyperconvex structure. Fixed Point Theory and Algorithms for Sciences and Engineering, Article 807.
18. Gardašević-Filipović, M., Kukić, K., &Gardašević, D. (2023). Some best proximity pointresults in orthogonal-complete-metric-like spaces. Journal of Contemporary Mathematics Analysis (Armenian Academy of Sciences), 58 (2), 105–115 .
19. Guo, P., Li, F., & Xu, Z. (2025). Non-compact Schauder fixed point theorem in random normed modules. Journal of Mathematische Annalen, 391 (3), 3863–3911.
20. Haque, I., & Ali, J. (2024). Best proximity point theorems via measure of noncompactness and application to a system of Caputo fractional differential equations. Journal of Filomat , 38 (14) , 5099–5111.
21. Huang, S., & Du, W. (2024). Generalized Meir–Keeler type fixed points for nonlinear mappings. Journal of Symmetry, 16 (8), Article number:1088 (Symmetry uses article-numbers instead of traditional page ranges)
22. Janardhanana, G., Mania, G., Mitrović, Z., Aloqaily, A., &Mlaiki, N. (2025). Best proximity point results on .Journal of Mathematics and Computer Science**,** 38**(1),** 45–55**.**
23. Jleli, M., & Samet, B. (2025). On Banach's fixed point theorem in perturbed metric spaces. Journal of Applied Analysis & Computation, 15 (2), 993–1001
24. Keçeci, S. (2025). Diversity of Keçeci numbers and their application to Prešić-type fixed-point iterations. Journal article / Open Science Articles (OSAs)" entry, 10.5281/zenodo.15483569
25. Khan, J., &Alhartomi, A. (2024). Fixed-point recurrent neural networks for efficient embedded hardware. Journal of IEEE Transactions on Neural Networks and Learning Systems, 36 (5), 8240–8254 .
26. Lateef, D. (2023). Best proximity points in $\mathscr{F}$-metric spaces with applications. Journal of DemonstratioMathematica ,56(1), 1–14.
27. Liu, Y., & Zhang, X. (2025). Upper tail field of the KPZ fixed point. Journal of Communications in Mathematical Physics, 406 (8) , Article 198 (i.e., "406 (8): 198")
28. Moussaoui, A., &Radenović, S. (2025). Fuzzy metric spaces: A survey on fixed point results, contraction principles and simulation functions. Fixed Point Theory and Algorithms for Sciences and Engineering. 2025, Article number 24
29. Moussaoui, A., Park, C., &Melliani, S. (2025). New best proximity point results via simulation functions in fuzzy metric spaces. Journal of Boletim da Sociedade Paranaense de Matemática, 43 (2025), 1–12 .
30. Özgür, N., & Taş, N. (2023). Geometric properties of fixed points using simulation functions. Advanced Studies: Euro-Tbilisi Mathematical Journal, 16 (4) , 91–108.
31. Pant, R. P., Rakočević, V., Gopal, D., & Joshi, B. (2025). A new approach to metrical fixed point theorems. Mathematica Slovaca, 75(1), 1–12.
32. Park, M. (2023). A metatheorem in ordered fixed-point theory. Journal of Advances in Mathematics and Computer Science, 38(1), 52–67.

33. Patle, P. R., Gabeleh, M., &Rakočević, V. (2023). New best proximity point (pair) theorems via MNC and application to the existence of optimum solutions for a system of Hilfer fractional differential equations. Journal of Revista de la Real Academia de Ciencias Exactas , 117 (3) , Article 124.
34. Paunović, M., Haddadi, M. R., & Parvaneh, V. (2024). Generalization of simulation functions for finding best proximity pair, best proximity point and best proximity coincidence point. Journal of Filomat , 38 (8), 2847–2856.
35. Petruşel, A., Petruşel, G., & Yao, J. C. (2025). Fixed points and best proximity points for some general classes of multi-valued operators. Journal of Optimization , 74 (10), 2483–2498.
36. Pradhan, A., Gabeleh, M., & Patel, D. K. (2025). Best proximity point (pair) theorem using (α–ς) Meir–Keeler condensing operators in Busemann convex spaces. Journal of Applied General Topology, 26 (2) , 763–784 .
37. Pradhan, A., Gabeleh, M., Patel, D. K., &Samei, M. E. (2025). Best proximity point (pair) theorem using (α–ς) Meir–Keeler condensing operators in Busemann convex spaces. Advances in Geometry and Topology, 10(2), 1–14.
38. Pragadeeswarar, V., & Unni, A. S. (2026). Common best proximity point theorems in neutrosophic complete metric spaces. Journal of Neutrosophic Sets and Systems, 95 (2026), 26-45.
39. Raj, V. S., & Gomathi, S. (2024). A best proximity point theorem for relatively nonexpansive mappings in the absence of the proximal normal structure property. Journal of Fixed Point Theory, 25 (1), 333–338 .
40. Ramaswamy, R. R., Murthy, P., Sahu, P., et al. (2025). Application of fixed pointresultto boundary value problems using M-type generalized contraction for best proximity point considerations. AIMS Mathematics, 10(1), 1–18.
41. R-metric spaces with applications to fractional differential equations and production–consumption equilibrium. Journal of Mathematical and Computational Science. Vol. 38, Issue 1, pp. 45–55.
42. Sabri, R. I., & Ahmed, B. A. A. (2023). Best proximity point theorem for $\tilde{\alpha}$–$\tilde{\psi}$-contractive type mapping in fuzzy normed space. Baghdad Science Journal, 20 (5), Article 22.
43. Sabri, R. I., & Ahmed, B. A. A. (2025). Iterative approximation of best proximity points of MT cyclic contraction mappings. Baghdad Science Journal, 22 (9) , 3037–3044.
44. Safari-Hafshejani, A. (2025). Error estimates for approximating coupled best proximity points in uniformly convex Banach spaces. Journal of Applied Mathematics & Data Analysis, Vol. 41, No. 1 (2025), pp. 193–204.
45. Saleem, N., Raazzia, M. T., Hussain, N., & Asiri, A. (2023). Geraghty–Pata–Suzuki-type proximal contractions and related coincidence best proximity point results. Journal of Symmetry**,** 15(8), 1572**.**
46. Sezen, M. S. (2025). Interpolative best proximity point results via ψ-contraction with applications. Journal of AIMS Mathematics , 10 (1), 1350–1366.
47. Sezen, M. S. (2025). Interpolative best proximity point results via γ-contraction with applications. AIMS Mathematics, 10(1), Article 062.
48. Sezen, M. S., Türkoğlu, A., & Saleh, H. N. (2025). Best proximity point theorems for interpolative Kannan-type and Ćirić–Reich–Rus-type $\mathscr{L}$-proximal contractions. Journal of Fixed Point Theory and Algorithms for Sciences and Engineering, Article 793.
49. Thong, D., Nguyen, L., & Tran, P. (2025). Double-inertial algorithms for split fixed-point problems. Journal of Computational and Applied Mathematics, 44 (1), Article 102 (i.e. "44(1), 102–")
50. Touail, M., Karim, A., & Rachid, M. (2023). A new contribution in fixed point theory via auxiliary functions. Journal of Ricerche di Matematica, 72 (1), 181–191.
51. Unni, A. S., &Pragadeeswarar, V. (2025). Existence and uniqueness of best proximity point in non-Archimedean neutrosophic complete metric space. Journal of Neutrosophic Sets and Systems , 91 (2025) , 793–811.
52. Unni, A. S., &Pragadeeswarar, V. (2025). Existence and uniqueness of fractals in fuzzy metric space via best proximity point. Journal of Rendiconti del CircoloMatematico di Palermo, 74 (2025), Article 160.

53. Younis, M., & Öztürk, M. (2025). Some novel proximal point results and applications on extended .Universal Journal of Mathematics and Applications, 8(1), Pages 8-20.
54. Younis, M., Ahmad, B., & Ali, K. (2025). Convergence analysis of chaotic dynamics in fractional order Chua's attractor. Alexandria Engineering Journal, 110 (2025) , 363–375.
55. Younis, M., Ahmad, H., & Shahid, W. (2024). Best proximity points for multivalued mappings and equation of motion. Journal of Applied Analysis & Computation, 14 (1), 298–316.
56. Yuan, J. (2025). Fixed point theory in p-vector spaces. journal Fixed Point Theory and Algorithms for Sciences and Engineering, Vol. 67(5), pages 962–986.

